Rejection under §102

Claims 1, 4, and 9 have been rejected under 35 USC §102 (e) as being anticipated by Summerfelt et al. (U.S. Patent No. 6,319,542). Claim 1 has been amended to recite "oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma" and "depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface." In order to be anticipated, a prior art reference must disclose every element and limitation of a claim to be anticipating under 35 U.S.C. §102. *See Carella v. Starlight Archery and Pro Line Co.*, 804 F.2d 135, 138, 231 U.S.P.Q. 644, 646 (Fed. Cir. 1986). Neither of these features are taught in Summerfelt et al.

Summerfelt et al. teaches a method of forming a capacitor using lightly donor doped electrodes for high-dielectric-constant materials. A capacitor is taught having a La donor doped BST layer 34 deposited on a SiO_2 layer 32. See col. 3, line 67 – col. 4, line 1. In an alternate embodiment, the capacitor is formed by placing a TiN upper electrode 38 over an undoped high-dielectric-constant BST layer 36. See col. 4, lines 22-23. The BST layer 36 overlays a lightly La donor doped BST lower electrode 34. See col. 4, lines 23-24. The lightly La donor doped BST lower electrode is formed on a TiN electrode buffer layer 42. See col. 4, lines 25-27. Thus, the high-dielectric-constant material of Summerfelt et al. is not deposited **directly onto** the oxidized surface of a **non-oxide electrode** as required by amended claim 1, as the high-dielectric-constant materials are overlay the BST lower electrode 34.

The Examiner asserts in the Advisory Action that Summerfelt et al. teaches in TABLE that the non-oxide electrode can comprise TiN/TiO/TiON, which is a non-oxide electrode with an oxidized upper surface. Summerfelt et al. teaches that the **electrode buffer layer** 42 can be TiN/TiO/TiON in the TABLE. However, TiN is not a non-oxide electrode with an oxidized upper surface. TiO/TiON are oxides, however, that is no indication that the **upper surface** of the layer is oxidized. There is nothing in Summerfelt et al. that teaches that the upper surface of the electrode buffer layer 42 is oxidized, as recited in amended claim 1.

Even if Summerfelt et al. does teach oxidizing the upper surface of a non-oxide electrode, the present invention is not taught. The deposition of the lightly La donor doped BST lower electrode 34 is performed in a slightly reducing atmosphere in order to minimize the oxidation of the TiN in the TiN lower electrode buffer layer 42. See col. 4, lines 55-58. Summerfelt et al further teaches that the deposition of the undoped high-dielectric constant BST layer 36 generally requires oxidizing conditions. See col. 4, lines 59-61. The light La donor doped BST lower electrode 34 will significantly slow the oxidation rate of the TiN electrode buffer layer 42, inhibiting the formation of a substantially oxidized continuous resistive contact layer. See col. 4, lines 61-64. However, there is no teaching in Summerfelt et al. of oxidizing the upper electrode using an **O_3 gas plasma**. Therefore, every element or limitation of claim 1, as amended, is not taught in Summerfelt et al. Thus, claim 1, as amended, is not anticipated by Summerfelt et al. Claim 4 which depends from claim 1 has been canceled.

Claim 9 has been rejected as being anticipated by Summerfelt et al. Claim 9, as amended recites "oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma." Also, claim 9 has been amended to recite "depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As explained above in the arguments for claim 1, as amended, Summerfelt et al. does not teach either of these features. Therefore every element or limitation of claim 9, as amended, is not taught by Summerfelt et al. Thus, claim 9, as amended, is not anticipated by Summerfelt et al.

Rejection under §103

Claims 2, 3, 5-8, 10-29, and 38-41 have been rejected under 35 USC §103 (a) as being unpatentable over Summerfelt et al. Claims 2, 3, 5, 6, and 8 depend from claim 1, therefore, claim 1 will be argued as representative of claims 2, 3, 5, 6, and 8. Claim 7 has

been canceled. As stated above, claim 1 has been amended to recite "oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma" and "depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." Applicants submit that claim 1, as amended, is nonobvious over Summerfelt et al.

In order to establish a prima facie case of obviousness, the Examiner has the burden of proving, by reasoning or evidence, that: 1) there is some suggestion or motivation, either in the reference itself or in the knowledge available in the art, to modify that reference's teachings; 2) there is a reasonable expectation on the part of the skilled practitioner that the modification or combination has a reasonable expectation of success; and 3) the prior art reference must teach or suggest all of the claim limitations. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Both the teaching or suggestion and the reasonable expectation of success must be found in the prior art and not based on an applicant's disclosure. *Id.*

In carrying this burden, the Examiner "must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious." Ex parte Clapp, 227 USPQ 972, 973 (PTOBPAI 1985). A rejection based on § 103 clearly must rest on a factual basis, and these facts must be interpreted without hindsight reconstruction of the invention from the prior art. *In re Warner*, 154 USPQ 173, 178 (CCPA 1967). The Examiner may not, because he may doubt that the invention is patentable, resort to speculation, unfounded assumptions, or hindsight reconstruction to supply deficiencies in his required factual basis. *Id.*

The Examiner asserts that Summerfelt et al. teaches a method for forming a capacitor, comprising: providing a non-oxide electrode 42, such as TiN; depositing a high dielectric-constant oxide dielectric material 34, 36 on the oxidized surface of the non-oxide electrode; and depositing an upper electrode 38. Applicants respectfully point out that reference numeral 34 is directed to the lower electrode which is conductive, not the dielectric layer which is insulative.

Summerfelt et al. does not teach or suggest depositing the high-dielectric constant directly onto the oxidized surface of a non-oxide electrode. First, there is nothing in Summerfelt et al. that would suggest or motivate one of ordinary skill in the art to oxidize the upper surface of the non-oxide electrode using an O_3 gaseous plasma and then depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of the non-oxide electrode as recited in the claimed invention because Summerfelt et al. teach away from oxidizing the upper surface of a non-oxide electrode.

A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. *In re Gurley*, 31 USPQ2d 1130, 1131 (Fed Cir. 1994). The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. *Id.*

Summerfelt et al. teach away from the claimed invention because Summerfelt et al. do not want the TiN electrode buffer layer 42 to be oxidized. Summerfelt et al. teach that in order to **minimize** oxidation of the TiN lower electrode buffer layer, the BST lower electrode is deposited in a slightly reducing atmosphere. See col. 4, lines 55-60. Summerfelt et al. further explains that the deposition of the undoped high-dielectric-constant BST layer 36 generally requires oxidizing conditions. See col. 4, lines 58-60. The BST lower electrode 34 will protect the TiN electrode buffer layer 42 and inhibit formation of a substantially oxidized continuous resistive contact layer. See col. 4, lines 60-64. Thus, little if any oxidization occurs on the upper surface of the non-oxide electrode.

The totality of a reference's teachings must be considered. *Id., citing W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1550-51, 220 USPQ 303, 311 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). When the totality of the reference's teachings

are considered, it is apparent that Summerfelt et al. teach a completely different capacitor that is formed in a completely different manner. Thus, there is no reasonable expectation on the part of the skilled practitioner that the modification or combination has a reasonable expectation of success.

Summerfelt et al. explains that the BST lower electrode 34 is deposited in a slightly reducing atmosphere when the TiN electrode buffer layer 42 is used in order to minimize the oxidation of the TiN. Furthermore, The BST lower electrode 34 overlies the TiN electrode buffer layer 42, thereby, protecting the TiN electrode buffer layer 42 from oxidation while the high-dielectric constant BST layer 36 is deposited. Thus, the TiN electrode buffer layer 42 is not purposefully oxidized, but rather may only possibly be incidentally oxidized due to the environment which is required for the deposition of the other layers of the capacitor. It is clear when reading the totality of the reference's teachings, that steps are taken in the formation of the capacitor taught Summerfelt et al. to assure that the TiN electrode buffer layer 42 is protected from oxidizing circumstances. Therefore, one of ordinary skill in the art would not find suggestion or motivation from Summerfelt et al. to modify the teaching of Summerfelt et al. to make the claimed invention as the claimed invention **requires** oxidation of the upper surface of the non-oxide electrode.

Second, Summerfelt et al. only teaches depositing the high-dielectric constant material onto the lower electrode 34. The lower electrode 34, which is an oxide electrode, is deposited over the electrode buffer layer 42. Even if the upper surface of the electrode buffer layer 42 is oxidized, the high-dielectric constant material is not deposited **directly onto** the oxidized surface of a non-oxide electrode, as required by claim 1 as amended. Rather the lower electrode 34 is deposited onto the oxidized surface of the electrode buffer layer 42. There is no teaching or suggestion in Summerfelt et al. to deposit the high-dielectric constant material differently.

Furthermore, there is no mention in Summerfelt et al. of using a gaseous plasma to oxidize the TiN electrode buffer layer. Rather, Summerfelt et al. simply states that the

deposition BST layer 36 generally requires oxidizing conditions with no indication of the using a gaseous plasma when depositing BST layer 36. Thus, claim 1, as amended, is nonobvious over Summerfelt et al. Thus, claims 2, 3, and 5-8 are also nonobvious over Summerfelt et al.

Claims 9, 16, and 22 have been amended to recite "depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." Claims 9 and 16 have been amended to also recite "oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma." As shown above in the arguments for claim 1, as amended, Summerfelt et al. does not suggest these features. Thus, claims 9, 16, and 22, as amended, are nonobvious over Summerfelt et al. Claims 14 and 20 have been canceled. Claims 10-13 and 15 depend from claim 9 and claims 17-19, and 21 depend from claim 16, therefore claims 10-13, 15, 17-19, and 21 are nonobvious over Summerfelt et al.

Claims 23, 25, 38, and 41 have been amended to recite "depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." In addition, claims 23, 25, 29, 38, 39, 40, and 41 already recite "oxidizing an upper surface of said non-oxide electrode in an atmosphere containing a gas plasma." As shown above in the arguments for claim 1, as amended, Summerfelt et al. does not suggest these features. Thus, claims 23, 25, 29, 38, 39, 40, and 41, as amended, are nonobvious over Summerfelt et al. Claim 24 depends from claim 23 and claims 26-28 depend from claim 25, therefore claims 24 and 26-28 are nonobvious over Summerfelt et al.

New claims 42-44 have been added, which recite "depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As shown above, this limitation is not taught or suggested by Summerfelt et al. Thus, claims 42-44 are patentable over Summerfelt et al.

Admissions

The Examiner makes a number of admissions on pages 3 and 4 of the office action mailed on August 21, 2002. The Examiner first admits that Summerfelt et al. does not teach providing a field effect transistor having a pair of source/drain regions, wherein one of the source/drain regions is connected to the capacitor electrode and the other source/drain region is connected to a bit line, as recited in claim. The Examiner maintained that this would have been obvious to one of ordinary skill in the art. However, claim 38 also recites "depositing a layer of high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As shown above, this is not taught or suggested by Summerfelt et al. Thus, a claim 38 is nonobvious over Summerfelt et al.

The Examiner next admits that Summerfelt et al. does not teach a method wherein the high-dielectric oxide is Al_2O_3, Ta_2O_5 or $Ba_xSr_{(1-x)}TiO_3$, as recited in claims 5, 10, 16, 28, 29, and 39. The Examiner contends that this would have been obvious to one of ordinary skill in the art. However, claims 5, 10, 16, 28, 29, and 39 either recite or depend from a claim that recites "depositing a layer of high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As shown above, this is not taught or suggested by Summerfelt et al. Thus, claims 5, 10, 16, 28, 29, and 39 are nonobvious over Summerfelt et al.

The Examiner admits that Summerfelt et al. does not teach a method, wherein the oxidation is carried out in a temperature ranger of 250° to about 700° C, or 250° to about 500° C, as recited in claims 2, 8, 12, 15, 18, 21, 23, and 26. The Examiner contends that this would have been obvious to one of ordinary skill in the art. However, claims 2, 8, 12, 15, 18, 21, 23, and 26 either recite or depend from a claim that recites "depositing a layer of high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As shown above, this is not taught or suggested by Summerfelt et al. Thus, claims 2, 8, 12, 15, 18, 21, 23, and 26 are nonobvious over Summerfelt et al.

The Examiner admits that Summerfelt et al. does not teach a method, wherein the oxidation is carried out in an O_2, O_3, H_2O or N_2O gas as recited in claims 2, 11, 17, 23, 25, 29, 39, and 40. The Examiner contends that this would have been obvious to one of ordinary skill in the art. However, claims 2, 11, 17, 23, 25, 29, 39, and 40 either recite or depend from a claim that recites "depositing a layer of high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As shown above, this is not taught or suggested by Summerfelt et al. Thus, claims 2, 11, 17, 23, 25, 29, 39, and 40 are nonobvious over Summerfelt et al.

The Examiner admits that Summerfelt et al. does not teach a method, wherein the oxidation of the upper surface is performed in an oxide dielectric deposition chamber prior to deposition of the high-dielectric constant oxide material as recited in claims 6, 13, 19, and 39. However, claims 6, 13, 19, and 39 either recite or depend from a claim that recites "depositing a layer of high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode." As shown above, this is not taught or suggested by Summerfelt et al. Thus, claims 6, 13, 19, and 39 are nonobvious over Summerfelt et al.

In light of the amendments and arguments above, the recited features require the steps of oxidizing an upper surface of the non-oxide electrode with a gas plasma and depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of the non-oxide electrode. As shown above, these steps are novel and nonobvious over Summerfelt et al, despite the admissions by the Examiner. Further, the Examiner has failed to establish, through evidence or reasoning, that one skilled in the art would have been motivated to modify Summerfelt et al to arrive at the claimed invention.

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In CONCLUSION

Applicants respectfully submit that, in view of the above remarks, the application is now in condition for allowance. Early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,

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Appendix

In the Claims

1. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode; oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma; depositing a high dielectric constant oxide dielectric material [on] directly onto the oxidized surface of said non-oxide electrode; and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

Please cancel claim 7.

8. (Amended) A method as claimed in claim [7] 1 wherein the oxidation is carried out at a temperature in the range of from about 250° to about 500° C.

9. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode selected from the group consisting of TiN, TaN, WN, and W, oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma, depositing a high dielectric constant oxide dielectric material [on] directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

Please cancel claim 14.

15. (Amended) A method as claimed in claim [14] 9 wherein the oxidation is carried out at a temperature in the range of from about 250° to about 500° C.

16. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode selected from the group consisting of TiN, TaN, WN, and W, oxidizing an upper surface of said non-oxide electrode using an O_3 gas plasma, depositing a high dielectric constant oxide dielectric material selected from the group consisting of Al_2O_3, Ta_2O_5 and $Ba_xSr_{(1-x)}TiO_3$ [on] directly onto the oxidized surface of

said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

Please cancel claim 20.

21. (Amended) A method as claimed in claim [20] 16 wherein the oxidation is carried out at a temperature in the range of from about 250° to about 500° C.

22. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode, in a deposition chamber oxidizing an upper surface of said non-oxide electrode, in the same deposition chamber depositing a high dielectric constant dielectric material [on] directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

23. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode, oxidizing an upper surface of said non-oxide electrode at a temperature in the range of from about 250° to about 700° C in an atmosphere containing a gas selected from the group consisting of O_2, O_3, H_2O, and N_2O, depositing a high dielectric constant dielectric material [on] directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

25. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode, oxidizing an upper surface of said non-oxide electrode in an atmosphere containing a gas plasma generated from a gas selected from the group consisting of O_2, O_3, H_2O, and N_2O, depositing a high dielectric constant dielectric material [on] directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

38. (Amended) A method of forming a DRAM cell comprising providing a non-oxide electrode, oxidizing an upper surface of said non-oxide electrode, depositing a layer of a high dielectric constant oxide dielectric material [on] directly onto the oxidized surface of said non-oxide electrode, depositing an upper layer electrode on said layer of said high dielectric constant oxide dielectric material, providing a field effect transistor having a pair of source/drain regions, electrically connecting one of said source/drain regions with said conductive oxide electrode and electrically connecting the other of said source/drain regions with a bit line.

41. (Amended) A method for forming a capacitor comprising: providing a non-oxide electrode selected from the group consisting of TiN, TaN, WN, and W, in a deposition chamber oxidizing an upper surface of said non-oxide electrode, in the same deposition chamber depositing a high dielectric constant oxide dielectric material [on] directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

42. (New) A method for forming a capacitor comprising: providing a non-oxide electrode; oxidizing an upper surface of said non-oxide electrode; depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode; and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

43. (New) A method for forming a capacitor comprising: providing a non-oxide electrode selected from the group consisting of TiN, TaN, WN, and W, oxidizing an upper surface of said non-oxide electrode, depositing a high dielectric constant oxide dielectric material directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.

44. (New) A method for forming a capacitor comprising: providing a non-oxide electrode selected from the group consisting of TiN, TaN, WN, and W, oxidizing an upper surface of said non-oxide electrode, depositing a high dielectric constant oxide

dielectric material selected from the group consisting of Al_2O_3, Ta_2O_5 and $Ba_xSr_{(1-x)}TiO_3$ directly onto the oxidized surface of said non-oxide electrode, and depositing an upper layer electrode on said high dielectric constant oxide dielectric material.